Mapping Ocean Wealth
White Paper
July, 2014

Introduction

This document describes a major new initiative to develop detailed and spatially explicit accounting of the value of marine ecosystem services at different scales. This information will inform key decision-makers in sectors ranging from international development to insurance and extractive industries to engineering. Our vision is to change perception and utilization of marine and coastal ecosystems. Working with stakeholders, we will catalyse a transformation in ocean management toward a paradigm based on explicit understanding of how and where "ocean wealth" is built, stored and generated.

Oceans cover more that 70% of the planet. They contain 80 percent of Earth's life. They are a major source of local, national and global wealth. An estimated 300 million people worldwide rely on fishing, aquaculture and tourism for a living. Fisheries alone contribute $100 billion per year to the global economy (FAO 2014). These livelihoods and financial drivers are crucial to coastal economies—and, in fact, national economies. At the same time, billions are being invested in coastal development and other economic activities in the oceans, including plans to help coastal communities adapt to climate change and rising seas. Investing that money based on ecosystem science is an opportunity we must seize. It is a rare—perhaps unprecedented—chance to enhance and restore the coastal habitats and to preserve livelihoods and economies informed by science.

The importance of oceans and seas to global wellbeing cannot be overstated. And yet, over the last 100 years, burgeoning populations and economies have greatly impacted the health of oceans. Overfishing, habitat loss, pollution, climate change and ocean acidification are all taking a substantial toll. These impacts are affecting the many benefits marine and coastal habitats provide including food production, coastal protection, water quality maintenance and more. In turn, this degradation puts communities at risk of significant economic and social losses.

A number of recent studies and global initiatives, such as the Millennium Ecosystem Assessment and The Economics of Ecosystems and Biodiversity (TEEB), have propelled awareness of the tremendous

value of nature and its substantial contribution to wellbeing and development outcomes. Unfortunately, this increased awareness has failed to lead to major policy and institutional changes, in part because many of the described benefits are viewed as disconnected from development and investment decisions.

Efforts to integrate ecosystem services benefits (ocean wealth) into decision-making require a more detailed, targeted approach focusing on socio-economic drivers for sustainable use, protection and restoration of ecosystems. Central to this approach is locally accurate, spatially explicit quantification of ocean wealth using metrics that can be understood and utilized by decision-makers at different scales and in different socio-economic settings and assimilated into existing and new coastal and ocean management. These metrics may vary depending on particular user-needs – engineers require maps and models explaining the variation of wave attenuation by mangroves; fisheries managers want to understand the differing patterns of fisheries enhancement by oyster reefs; planners need to know potential tourism revenues from coral reefs; and so forth.

Ocean wealth approaches will shape conservation and development policy, as well as public and private investment decisions. At the global level, significant leverage can be achieved through the Post 2015 Development Agenda, which will set the global targets and benchmarks for future sustainable development policy. The Convention on Biological Diversity (CBD) Strategic Plan and Aichi targets – which set out global targets and benchmarks for habitat conservation and restoration – and the UN Framework Convention on climate Change (UNCCC) and UN Post Hyogo framework for Disaster Risk Reduction – which set out the framework for adaptation and mitigation of climate and disaster risks – also offer key points of leverage at the global scale, influencing both development and conservation outcomes. At national and local scales, detailed quantification and valuation of ecosystem services will inform and influence decisions on the use of ocean spaces to meet development and conservation objectives, leading to policy reform and leveraging of public and private investments, with coincident economic benefits. Lessons learned at these more local scales need to be shared and scaled up to drive further uptake.

The challenge and focus of this project is to develop the knowledge base and demonstrate how such a paradigm shift can be applied in practice to influence policy.

Theory of change

Detailed, evidence-based and spatially explicit values for ecosystem benefits — such as fish production and storm protection — produced and delivered in a clear and useful way will lead to major changes in how ecosystems are viewed and utilized by multiple sectors. This, in turn, will create:

- policy shifts and greater public/private investment in protecting and restoring valuable marine and coastal habitats;
- increased utilization of integrated ocean management approaches, with an emphasis on securing long-term delivery of ecosystem benefits; and
- a culture of stewardship and sustainable practices based on risk assessment decision-making.

This will be achieved by:

A demand-driven approach: Changes to management and utilization of marine resources will be most effective when they are driven by internal demand from the users and beneficiaries of those services, rather than by external pressures. To maximize early uptake, it will be critical to identify those sectors most dependant on ecosystem benefits; pinpoint drivers of change and opportunities for influence; and propose policy options and enable conditions for the uptake and effective accounting of those benefits in decision-making processes.

Three priority sectors will be selected for in-depth analysis: first, climate and disaster risk reduction; second, fisheries; and, third, recreation and tourism. These sectors have some of the most immediately tangible value, whether measured in economic, employment or human safety and well-being metrics. Accordingly, they would be expected to be of the most-immediate influence.

Evidence-based quantification and mapping of values: Building on existing research and knowledge, the project will develop comprehensive models and maps of the ecological, social and economic components of ecosystem production functions, with reliable data and maps of fish production, flood mitigation, erosion control and recreation, and of the demand for those services at global and local scales and expressed using development relevant metrics. These metrics may be monetary, but could be expressed in other terms such as jobs, fish catches, tonnes of carbon and so on to account for those benefits in order to facilitate risk based decision-making approaches should habitats degrade and fail to deliver expected benefits.

Regional application: The project will demonstrate how to incorporate ecosystem benefits and values in integrated ocean management through regional applications, derived from needs assessments and policy reform opportunities. This will include the development of new data, the use of decision support tools, and trade-off analyses. The project proposes to target five regions initially: the Coral Triangle (Lesser Sunda Seascape); Micronesia (Palau and FSM); Mexico (Gulf of California); the USA (Mid-Atlantic Seascape); and the Caribbean (Cayman Islands).

Collaborative and additive research and data-sharing: This effort will require collaborations with a range of international partners, including scientific institutions as well as governmental, non-governmental and intergovernmental agencies necessary to undertake the scientific and policy work. Recognizing the growing body of practitioners engaged in ecosystem-service quantification, the project will seek to build collaboration and data-sharing at all stages, and will ensure that we target key gaps in understanding and avoid duplication. The project will establish a community of practice aimed at generating and facilitating access to knowledge.

Communication and engagement strategy: Engaging end users early will be critical to ensure that project outputs meet their needs and lead to the desired impact. Several end users have been identified beyond the “conservation engaged” public and conservation sector in general, including: national coastal planning agencies and coastal engineering interests; global and national management agencies and fisheries corporations; multilateral lending institutions; the reinsurance sector; marine based industry organizations; regulators; and policy makers.

The project will have achieved success when:

- Central Government Organizations and agencies are able to incorporate benefits of coastal and ocean habitats information in national and local decision-making processes
- Global development policy and investment decisions include protection and restoration of coastal and marine habitats as key options in ensuring secure and sustainable coastal development
- Governments, businesses and conservation interests are incorporating new "ocean wealth" information and models, and implement integrated oceans management, in the five targeted ocean geographies
- Partnerships and a community of practice arise and facilitate the development of a phase two of the project

In Phase 2, we anticipate this project will build on the research and policy developments, with a growing focus on economic valuation and trade-off analyses. It will also extend its focus towards new ecosystem services, including raw materials (timber, fiber, building materials) and non-use values and new ecosystems, including macroalgae and high-seas systems.

Policy drivers for mapping ocean wealth

While good policy must be grounded in science (including social sciences), science should likewise be driven by policy needs and opportunities in order to maximize its own influence. Science is one of many inputs that can lead to policy reform and changes in management. Such changes are also driven by political will, economic imperatives, perceived costs and benefits, and social values. Another shortcoming of science is that it leads to a clear analysis of a problem, but does not propose viable, cost-effective solutions. Without solutions, science's influence in the decision-making process is greatly diminished.

Policy components of the Mapping Ocean Wealth project will follow two broad tracks: first, it will provide general advice across the policy landscape to influence science, and the outputs and communications, in multiple sectors and across scales; second, it will focus in on two key areas of policy where the Mapping Ocean Wealth (MOW) project can have a direct and dramatic influence over a relatively short time-frame.

General advice:

- Review the science proposed and underway through the Mapping Ocean Wealth project and its partners, and advise on key audiences, information needs and outputs to help shape research agenda, outputs and communications
- Maintain a watching brief on multiple national and global policy forums[1] and look for opportunities to incorporate or otherwise highlight ecosystem service valuation
- Identify key drivers of loss of ecosystem benefits and policy options to reduce the risk
- Undertake a sector review of utilization, dependency or impact on marine ecosystem services
- Identify incentives and potential barriers to mainstreaming of ecosystem benefits and enable conditions and engagement strategy needed to promote their adoption.

[1] including UN Conventions and new entities such as the Global Partnership for the Oceans and the follow-on from the Global Ocean Commission

Key policy opportunities:

- Influencing the global development agenda, and notably the UN Post 2015 Development Agenda (UNHLP, 2013). Initially, the most fruitful area of focus will be around disaster risk response and hazard mitigation, describing and mapping the role of ecosystems both as coastal protection and through ancillary ecosystem service benefits such as water quality and food security.
- Influencing the international conservation community, including the Convention on Biological Diversity (CBD), and the global protected areas community, notably through the recognition and detailed incorporation of ecosystem service quantification into the CBD Strategic Plan and Aichi targets for conservation and restoration (CBD, 2010).

Partnership is a core element throughout the MOW project, and one critical partnership is with the Global Partnership for Oceans (http://www.globalpartnershipforoceans.org/), an alliance of some 150+ governments, industrial partners, and civil society organizations. This expanding group represents an important public-private mechanism to accelerate progress toward protecting and restoring ocean health through knowledge sharing and targeted investment in innovative and proven solutions.

Mapping ocean wealth – the science base

At the heart of the MOW project is an understanding that the existing body of scientific evidence is sufficient to drive change in understanding and policy. To achieve change, however, we must transform disparate scientific sources into a compelling science-based narrative, and deliver this narrative in an actionable way in language of engineering, finance and politics such that change is not only possible, but imperative.

A modular approach

Initial work will occur in a modular fashion around key services and key ecosystems (Figure 1). Work in some of these sectors is already well underway, both within The Nature Conservancy (TNC) and with others with whom we hope to collaborate, build partnerships, and share data.

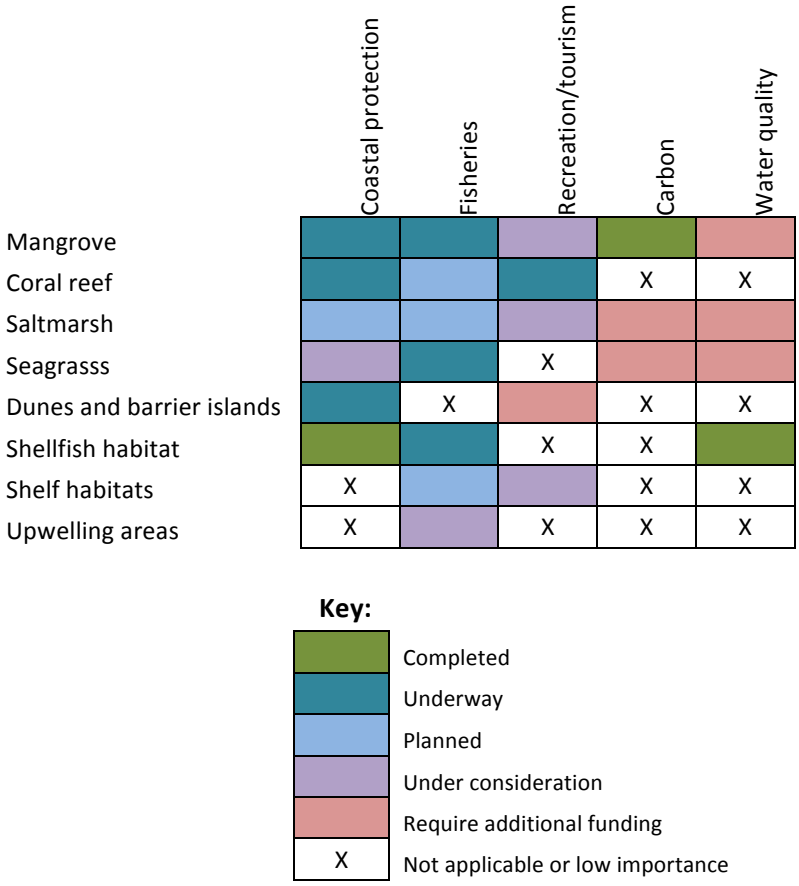

Figure 1: Key ecosystems and services identified for review, modeling and mapping at regional to global scales under Phase 1 of the MOW project.

For any given ecosystem service pairing, the MOW science process follows three broad stages:

1. **Review:** A detailed and systematic review of the expert literature on any given service which may describe, quantify and explain the service in terms of value and/or drivers of value. The output should include a synthesis report of the ecosystem service and the drivers of variance in value of that service, as well as a full bibliography.
2. **Modeling:** From the review process, it is possible to develop models that describe and quantify ecosystem service value in different places. The quality and reliability of such models will vary, depending on the quality of the input data from conceptual models to detailed numerical algorithms.
3. **Mapping:** Maps provide a compelling tool in many settings and will be a key output. Maps will be useful at multiple scales, although resolution and spatial accuracy of such maps will depend both on the model and on the input data used to generate values.

Partnership and engagement are key components of this process, and the identification and incorporation of expert input at all stages will expedite and improve data-gathering, modeling and mapping, all while communicating the work and the findings across the expert community.

All three stages will build valuable outputs for a range of users – review reports and bibliographic data will help on-going research science, and may be freely used by others seeking to replicate, or to develop their own models. Models, likewise, may enable others to develop or assess ecosystem

service values in their own areas of interest. These models can be modified, for example, to develop metrics of value for key users or outputs. Models could also be used independently for the preparation of output maps and tools not directly linked to the MOW project.

Care and attention will be given to ensure that the accuracy and reliability of these models are adequately described, and yet recognizing that uncertainty should not be a barrier to utilization, but rather a key component of all natural, physical, economic and other models.

Integrating values, modeling trade-offs
Single-ecosystem and single-service studies are valuable, but the information they provide on the value of any whole ecosystem is often inadequate to frame arguments to influence policy and management of natural resources.

Two further components must be built in:

- **Ecosystem service bundles:** The great value of most ecosystems is their ability to deliver multiple benefits, which must be considered in total. In some cases, it may be adequate to sum such benefits, but a more realistic approach will be to recognize likely synergies and trade-offs between various benefits at any given location. For example, harvesting shellfish habitat may reduce its capacity to generate other fish-stocks or reduce coastal erosion. By that same measure, ecosystems seldom operate in isolation, but instead interact with adjacent systems: mangroves and coral reefs both reduce wave energy, and likewise mangroves may be necessary to hold back sediments that might otherwise threaten the continued existence of coral reefs, and so forth.

- **Trade-offs:** The "case" for maintaining or enhancing ecosystem services can only be made in relation to alternative options. Thus, alongside the need to understand how ecosystem services can be additive or complementary, there is a need to build an understanding of how these multiple benefits relate to other sectors and alternative uses. This may include comparing the cost of maintaining a natural ecosystem set against the alternative cost of, for instance, additional sewage treatment or coastal defenses that might be necessary down the road. Alternatively, lost economic opportunities arising from not building aquaculture ponds, deep-water ports or hotels could be considerable, as well. It is important to recognize that using ecosystem service arguments will not always lead to conclusions that encourage the maintenance of ecosystems.

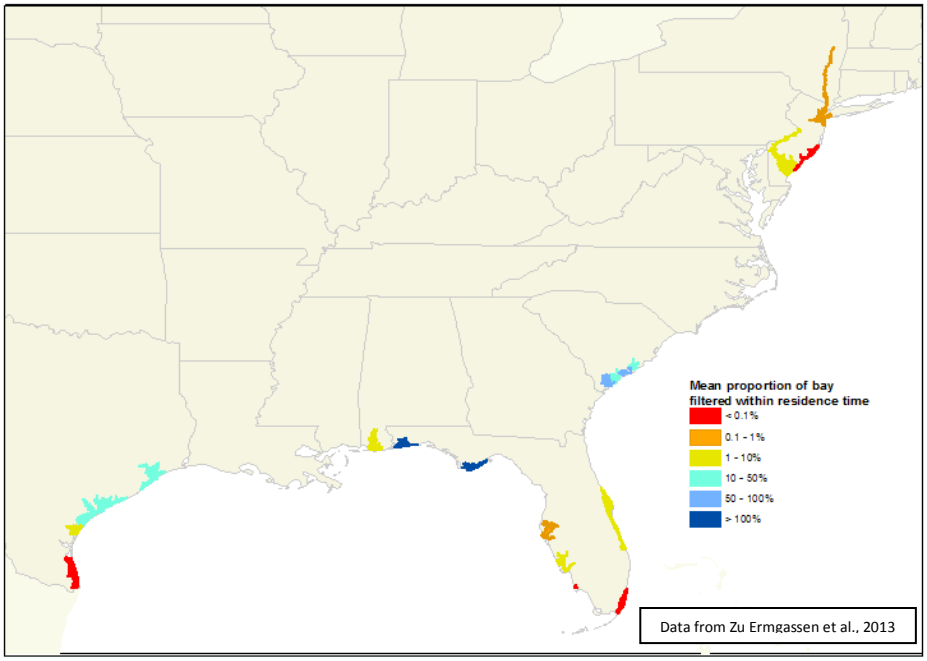

Figure 2: Map of water filtration capacity of oyster reefs by eastern oysters

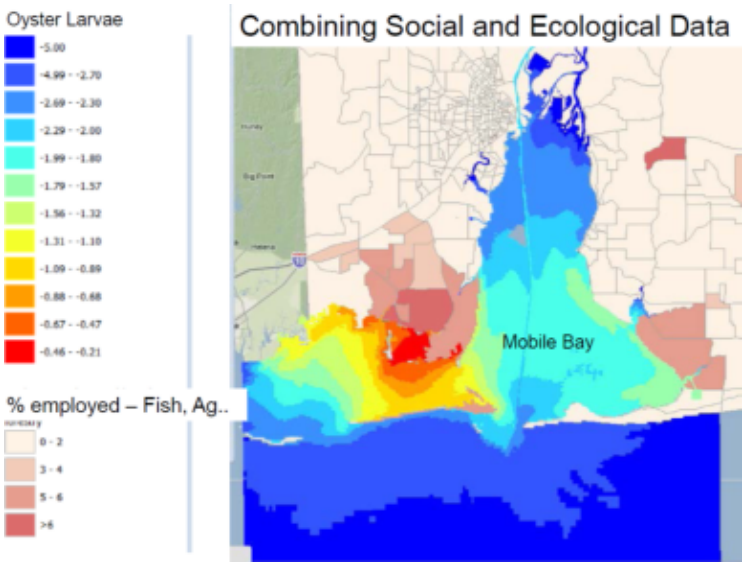

Figure 3: Maps the relationship of oyster productivity with percentage of people employed in fisheries and agriculture

Metrics

Understanding value, and the drivers of value, is inherently complex. We need to recognize complexity and build models that approximate as much of this reality as possible. Initial models will develop production functions for individual ecosystem services, focusing on ecological production functions (Barbier, 2012; Polasky and Segerson, 2009), and the social or economic production functions that define value in human terms.

The need to report the full complexity of processes in a way that is accessible to the intended audiences will guide how we develop outputs. Simple, powerful messages are important. Equally important is the need for a variety of metrics, depending on the services measured and the audiences affected. Economic values alone are rarely sufficient. Other metrics might include harvest biomass, jobs, food security, risk reduction and so forth. It may also be important to recognize that the same ecosystem services may have very different values for specific constituencies or users. A "cost" to commercial fisheries may be a "benefit" tourism/recreation sector, for instance.

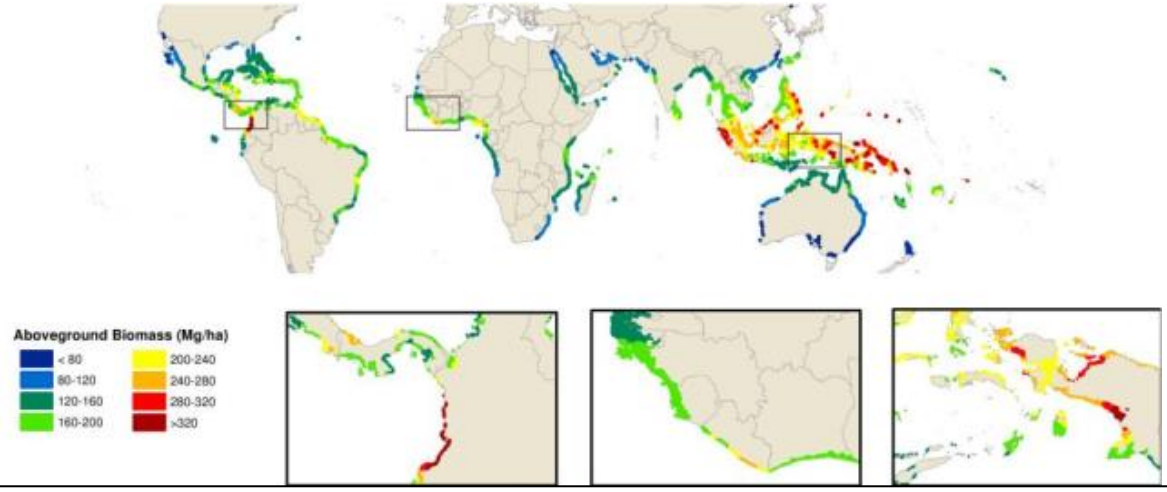

Figure 4: Global mangrove map showing modelled patterns of above-ground biomass per unit area.

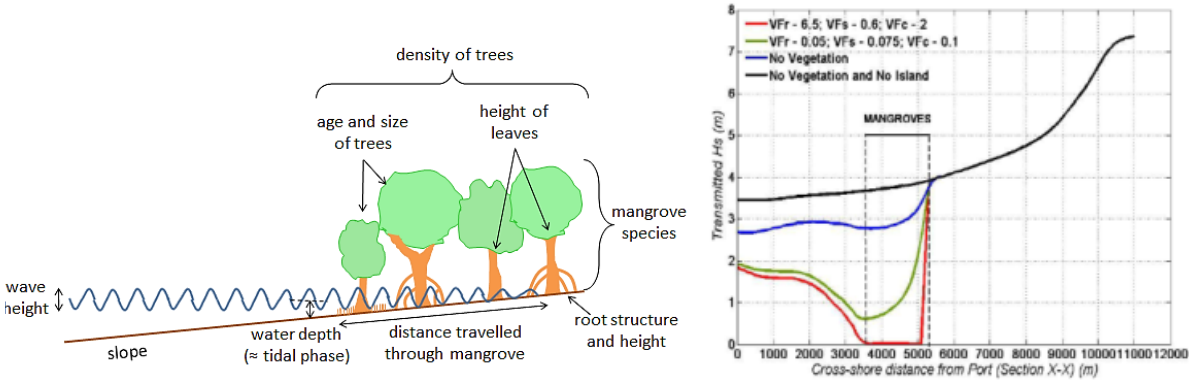

Figure 5: Relationship of density of mangrove trees and wave height reduction. In areas of higher tree density, wave height is reduced.

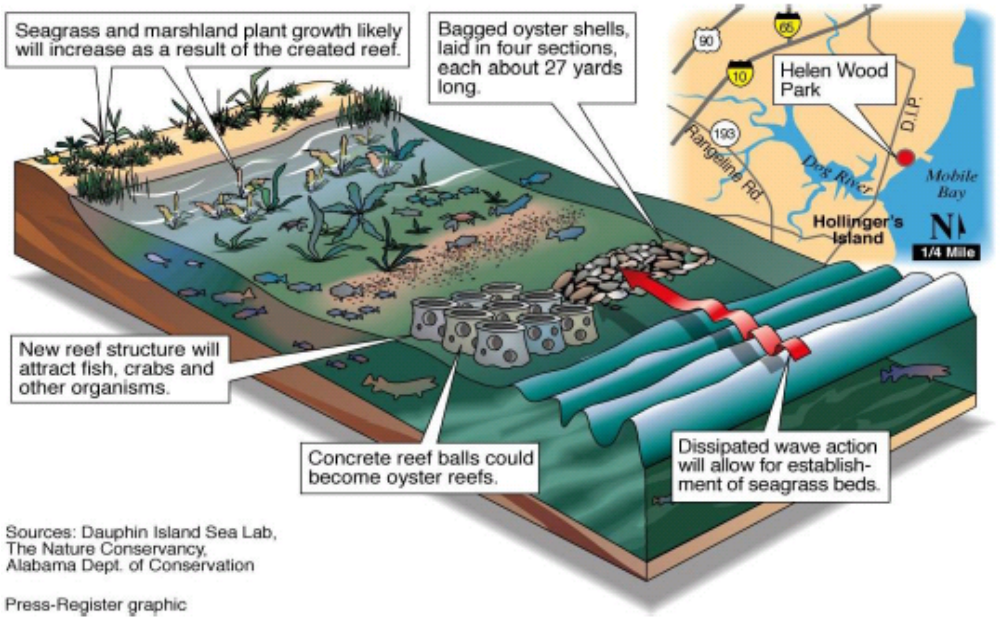

Figure 6: Illustrates better management of oyster beds and creation of new oyster beds can lead to increases in coastal protection and food production.

Working at multiple scales

Mapping Ocean Wealth will occur at different resolutions, from the broad (i.e., national, regional and global) to the fine (i.e., bays, wetlands and local projects). In better understanding the scientific drivers of value, we can build simple global models, but the same knowledge, combined with fine-grain data describing the multiple drivers of value, can also be used to build maps suitable for planning and management.

Broad-scale approaches are critical to inform decision-making and evolving policies at national and international levels, but can also build scientific understanding and tools necessary to support actions from local-scale management to global-scale investments.

Fine-scale application helps to test, and to strengthen, on-going datasets and modeling approaches, but, equally importantly, it builds a body of practise that will leverage and enable wider utilization and uptake of MOW in other places

Key to the broad-scale work will be the modular science of review-model-mapping described above.

In Phase 1, the focus will be targeted towards a subset of services:

- Fisheries focusing on the added value that specific ecosystems provide
- Carbon storage and sequestration in living biomass and soils
- Coastal protection (erosion prevention, disaster risk reduction, sea level rise abatement)
- Waste treatment (de-nitrification, detoxification, water clarity)
- Recreation and tourism

Further, these studies will select a relatively small number of ecosystems, both coastal and in offshore waters, with initial work targeting mangroves, coral reefs, seagrasses, saltmarshes, shellfish reefs and offshore benthic habitats, such as gravel and rocky bottoms.

As research is compiled, additional investments will come in the development of valuations around multiple ecosystem services and building trade-off analyses. MOW will also incorporate maps and models into decision-support tools.

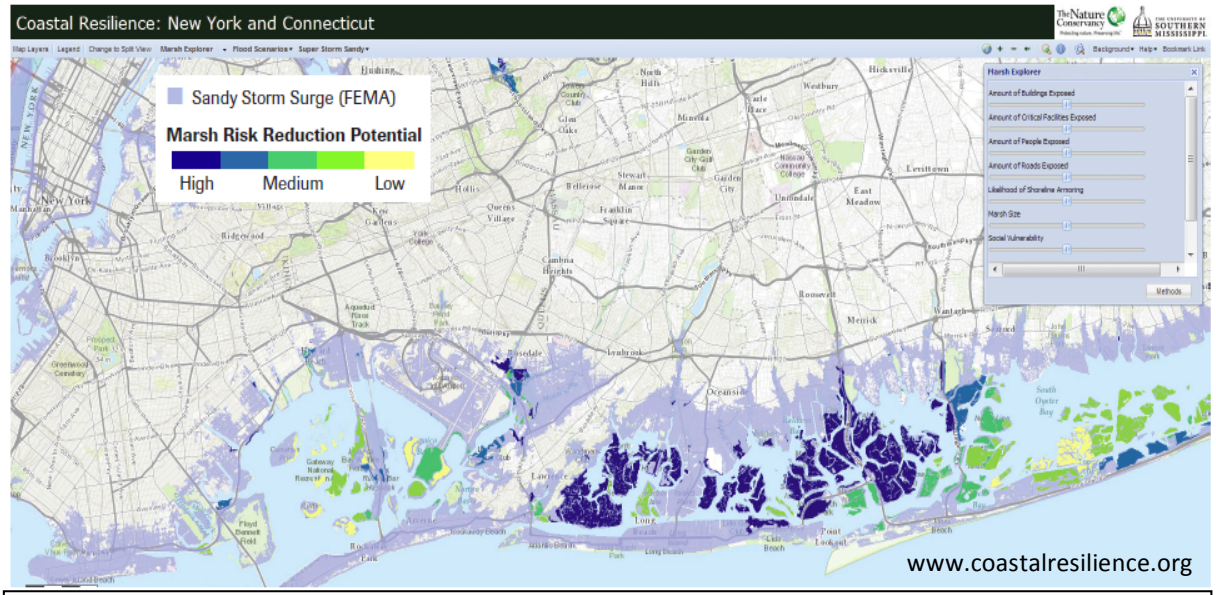

Figure 7: Local example of storm surge abatement by saltmarshes. The tool on the right is interactive and allows users to adjust based on different scenarios

Fine-scale approach
It is only at the finest scales that ecosystem service modeling and mapping can build towards an accurate reflection of reality. Every ecosystem service is the product of a complex interaction of physical, ecological and human drivers. Likewise, its value is driven by a range of social, cultural and economic factors that vary and are highly dependent on the perceptions and the realities of particular users.

At the scale of small islands or bays, it is possible to build models that replicate such realities by modeling multiple interacting ecosystem services and the complex physical and human landscapes that determine value. Such models are not only important for planning, but also for making a powerful case that the generic and necessarily simplistic models built at regional or global scales have a grounding in the real world.

In reality, there are existing examples from around the world where organizations are working with ecosystem service valuation in the everyday process of coastal planning and decision-making, in setting fisheries quotas and in establishing targets for ecosystem conservation or restoration.

The premise of the current work is that such efforts would benefit from better information and tools, and that the global lessons from such work must be shared, not re-learned.

Demonstrations
TNC and partners will support and facilitate the increased incorporation of ecosystem services valuation into on-going marine spatial planning. This will provide extra funding to gather data and improve maps. The work will benefit from the information and methods developed under the broad-scale approaches described above.

Our target geographies for data gathering include:

- Coral Triangle Lesser Sunda Seascape
- Micronesia Palau and FSM
- Mexico Gulf of California
- USA Mid-Atlantic shelf fisheries
- Caribbean Cayman Islands

While these regions are integral to the MOW project, we are keen to highlight other areas where such efforts have been undertaken or are underway and, in particular, to highlight the work of others in this field.

For example:

- Java, Indonesia Mangrove Capital Project with Wetlands International
- Belize, Jamaica World Resources Institute
- British Columbia, Canada Natural Capital Project
- Philippines and Indonesia World Bank Capturing Coral Reef Ecosystem Services project

Audience, outreach and influence

The scope of the MOW project as a whole is bold and multifaceted. Science and policy are at the core of its vision, but deep within there are multiple audiences ranging from technical to political and industry to investors. In some cases, they include local communities.

Critical to our success is effective communication, audience identification, and the understanding of needs, political realities and economic realities as well as barriers to action. Outputs for these audiences will vary, including web-based communication, printed documents, presentations, as well as significant earned news coverage, trade, opinion and social media strategies. The tone of outputs will vary depending on audience and will range from the technical to the emotional, all while retaining scientific rigor. Various spokespeople, including scientists, policy experts and other influential voices, will deliver our messages.

Influential audiences for our science, values and policy recommendations, include:

Academic Audiences – Gathering and influencing new peer-reviewed scientific literature, including journal articles and academic chapters, will grow the reach and influence of the MOW collaboration. Beyond peer-reviewed scientific publications, there is a need to communicate more broadly to technical and political audiences. To fill this need, we encourage collaborators to draft and produce more frequent opinions, practical recommendations, stories, videos, traditional and social media interviews and other ways of promoting the science and value of marine habitats.

Industry – Professional fields, including coastal engineering, insurance, and tourism, are important potential consumers of MOW content and findings. Trade publications, traditional and specialty media as well as industry associations, conferences and in-person meetings are complementary to our website and peer-reviewed content. Translating ecosystem science into the engineering and economic benefits might take many forms, including: reports and presentations delivered by a diverse group of spokespeople.

Community Planners and Managers – Agency staff and public sector managers in fisheries, community planning and infrastructure will be important collaborators and content developers. They might also become key advocates for using marine habitat for management decisions and coastal risk reduction. Ensuring that ecosystem science includes fish production potential and flood and storm risk reduction values is important for working with these public sector audiences to influence ocean protection and habitat restoration efforts.

Political – In order to drive policy change and investment in habitat protection and restoration, there is a need for policy briefs and materials that summarize technical work and build compelling practical solutions. Equally important will be delivering these ideas in places where they can have maximum influence, including national and international forums and policy discussions, often in collaborations with governmental or other partners.

Community – Politics are greatly influenced by public opinion. Demonstrating the value of nature in quantifiable and relevant economic, risk reduction and livelihood protection terms will build support for valuing marine habitat.

Web-site, information portal and mapping tools

Today, online communications are a critical component to effective communications. This is true for MOW as well, in presenting a compelling narrative and actionable information. We will develop a flexible website (oceanwealth.org) with specific consideration for conservation, agency, journalist and technical audiences, including:

- Summary pages and regular updates with case studies, examples of science in action, opinions and policy recommendations
- TNC, with significant input from partners and end users, will develop oceanwealth.org. We envision a hub for communications about the entire scope of work, specifically by the five regions describing how the work touches them locally, and for the science, policy and technical briefs drafted by partners
- Web-based mapping tools, following the structure of coastalresilience.org, will allow a range of users to build maps for key ecosystem services worldwide.
- An information portal intended to provide users with access to raw data, publications, maps and other information.
- Web-based information gathering could be valuable in using mapping or information portals to encourage data upload. This might include crowd-sourcing or wiki methods for developing new data sets to be included in Mapping Ocean Wealth.
- An Atlas of Ocean Wealth – Following the model of a number of other global atlas products, there is considerable potential in developing the findings and tools into an "atlas" (paper and digital) that provides an informative, illustrated instrument for exploring and explaining the range of ocean wealth values to multiple audiences.

Collaboration and data exchange

Collaboration is critical to Mapping Ocean Wealth. Growing numbers are working on the quantification of ecosystem services – the need for this information is great and there can only be benefits from data sharing and collaboration. As the MOW project grows, we remain keen to develop or support this growing network of experts with possible roles as a clearinghouse for data and information, and as a central hub for networking and other interactions. The aim will be to develop this with sensitivity and to maximize inclusivity.

In this process, we will engage new partners and see the boundaries between partners and audiences as surmountable. We hope that by engaging new players – including political, industrial and societal leaders – in specific aspects of the project, they will also see the benefits from marine ecosystems services more clearly and will work to promote and utilize findings.

Project management

The Mapping Ocean Wealth project is a shared endeavor and a collaborative effort involving many organizations and individuals with different strengths. The Nature Conservancy has organized a substantial team around its portion of this project, comprised of scientists, communications experts, policy specialists and others. The team is designed to facilitate collaboration within the organization and across different organizations to develop a new scientific understanding of ecosystem services and benefits, and to amplify the results for significant impact at several geographic scales.

An Advisory Team is now in place to connect work across organizations, to develop and implement policy, science and communications work that is part of the project, and to represent this project broadly throughout the field.

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